NOTE ADDED IN PROOF

I revisited Carnac Island from August 31 to September 7, 1976. Conspicuous changes in abundance of two seabird species were noted. About 100 Pied Comorant nests were found on the southern peninsula, resulting in considerable damage to the vegetation. Six nests each had one chick close to leaving the nest, and four nests had either eggs or very small chicks. The rest had already been used. Hundreds of cormorants were observed resting on this peninsula, as well as on Flat Rock.

The Crested Tern rookery on the NE peninsula was reduced to seven birds, and I found one nest with one egg, one nest with one small chick, and two runners. A pair of Caspian Terns nested in exactly the same place as 1975, and I found a scrape containing one large chick. No Bridled Terns had yet appeared.

THE COLLECTION OF POPLAR RUST SPORES BY HONEY-BEES

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SUMMARY

The Collection of uredospores of *Melampsora larici-populina* on *Populus nigra* var. *italica* by *Apis mellifera* is reported. Uredospores were identified from corbiculae as well as from the contents of larval food reserves in a bee-hive. This is the first record of the collection of rust spores by honey-bees.

INTRODUCTION

The spores of fungi have exploited the agents of wind and water very effectively for dispersal, there being few examples of insect-dispersed fungi. Insects are more often attracted to aromatic exudates, such as those associated with the conidia of *Claviceps* and pycnidiospores of some rusts, than they are to the spores themselves. Indirect dispersal of fungal spores by the movement of insects over infected trees or flowers can have serious consequences. The Dutch elm disease was effectively spread by bark-beetles. There are no reports in the literature on the collection of rust uredospores by insects. Rusts are important plant pathogens and the possible spread of rust spores by insects should not be overlooked.

OBSERVATIONS

During March and April, 1976, large numbers of the introduced honey-bee (*Apis mellifera*) were observed foraging amongst leaves of the Lombardy poplar (*Populus nigra* var. *italica*) in two stands, approximately 2 km apart, near Kalamunda. The trees were heavily infected with the European Poplar Rust (*Melampsora larici-populina* Klebahn). This plant pathogen was recently reported in Australia and New Zealand (Anon., 1974/5; Van Kraayenoord *et al.*, 1974; Walker *et al.*, 1974). The latter paper documents the detection, spread and host range of poplar rusts in Eastern Australia.

Infected leaves are characterized by necrotic patches, 2 - 5 mm across, on their upper surface corresponding to eruptions of uredia on the lower surface. The uredia produce elongated, spiny uredospores approximately 36 x 18 μm. The spores are bright yellow due to a pigment located inside the cells. Groups of yellow uredospores tend to aggregate because of their spines and fall in groups when the leaves are shaken. Due to their colour and dryness they have the superficial appearance of groups of pollen grains on the lower surface of the leaf. The lower leaves and older leaves are first infected by the disease, but on some larger trees examined, the disease had progressed about 18 m high to the top branches.

Bees were actively working infected poplar trees, gathering the yellow rust spores. Samples of bees collected from the trees had their corbi-

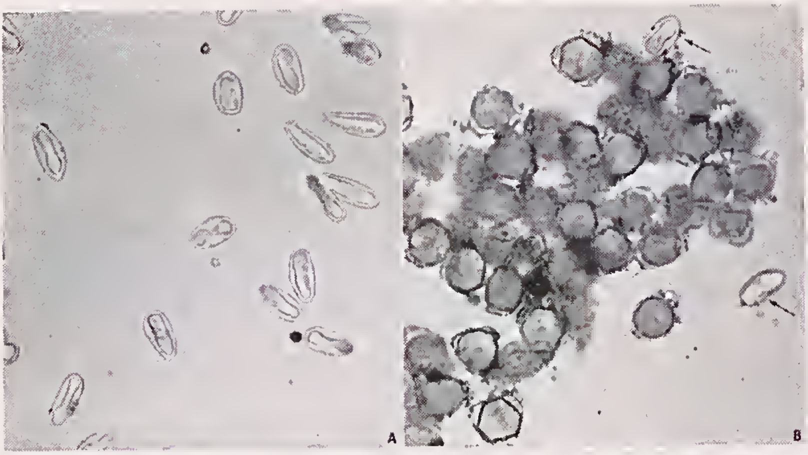

Fig. 1A.—Uredospores taken from the corbiculus of a bee foraging in poplar trees (x 170).

Fig. 1B.—Part of the contents of a nursery cell. The isodiametric cells are pollen grains. Two uredospores are arrowed (x 170).

culae (pollen baskets) packed with yellow material. Under the microscope (Fig. 1A), this was seen to contain the uredospores of *M. larici-populina.* Very little foreign matter was present.

At a distance of approximately 0.4 km from one stand of poplars, the contents of larval cells were removed from a bee-hive. The matrix consisted of a large number of marri *(Eucalyptus calophylla)* pollen grains and a smaller number of rust spores (Fig. 1B). The rust spores were recognizable because of their distinctive shape and yellow contents. This is good evidence that the bees were collecting rust spores for potential food. The hive was next to state forest and this would account for the large number of pollen grains. Apart from the stand of poplars mentioned above, the nearest poplars were over 2 km distant. It is unlikely that wind could have blown the spores into the hive because of the distances involved and the weight of the spore clumps. Sheridan *et al.* (1975) found very few rust spores in the air near poplar trees in New Zealand and suggested that the groups of spores were too heavy for wind dispersal.

DISCUSSION

The observation that bees were actively collecting uredospores of the European Poplar Rust raises some interesting points. It is not known, for example, why the bees were attracted to the spores. The spores are similar both in size and overall shape to many types of pollen and possibly could be mistaken by the bees as pollen grains. Apart from colour, bees may be attracted to potential food by scent. Adjacent to one stand of poplars, leaves of plum trees were heavily infected with the red-brown uredospores of the Plum Rust *(Tranzoschelia pruni-spinosae* (Pers.) Diet.). However, no bees were observed collecting these spores and no spores were present either in the samples taken from corbiculae or the bee-hive. This suggests that the bees may have been attracted to the poplar rust by the colour of the rust spores.

The value of rust spores as a food source for bee larvae needs to be established. Like most propagules it can be expected that the uredospores are highly nutritious. However, it is known that bees collect pollen and nectar which may be poisonous to bees (e.g. Bailey, 1963). Feeding experiments should be carried out to determine whether poplar rust spores are toxic to bees.

Clearly, foraging bees can lead to a rapid spread of the pathogen from tree to tree and may be responsible for the rapid dispersal of the disease in the Perth Metropolitan area. Sheridan *et al.* (1975) suggest that in New Zealand, sheep grazing under poplars and birds could be significant in dispersal of uredospores. The dispersal by bees appears to be more probable and should be investigated elsewhere.

ACKNOWLEDGEMENTS

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ROOT PARASITISM OF *HAKEA SULCATA* BY *NUYTSIA FLORIBUNDA*

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During a study of the effects of waterlogging on root growth of *Hakea sulcata* R.Br. (Proteaceae) (Lamont, 1976), a number of parasitic roots of *Nuytsia floribunda* (Labill.) R.Br. (Loranthaceae) were encountered. These haustoriogens (groups of haustoria forming rings around the host root) were first described in detail by Herbert (1919), and further studied by Grieve (1975) and Göbel (1975).

Resulting from this present study, Fig. 1A shows a rootlet of *N. floribunda* attached to a lateral of *H. sulcata* by a haustoriogen. The *H. sulcata* specimen was growing in a seasonally waterlogged depression in the Kenwick reserve of the Botany Department, University of Western Australia. A 2 m high specimen of *N. floribunda* was located within the swamp at a distance of about 4 m from the parasitized *H. sulcata,* and the next closest possible source was a 5 m specimen on a sandy rise about 13 m away.

Proteoid roots are dense clusters of rootlets found in most species of Proteaceae (Lamont, 1972a) and at least one legume (Lamont, 1972b). Fig. 1B is of particular interest for it shows portion of a proteoid root of *H. sulcata* parasitized by two haustoriogens. The two arms of the collar of the smaller haustoriogen have not yet merged. The fact that the *N. floribunda* roots have not parasitized the proteoid rootlets suggests *either* (a) that there is a minimum surface of contact requirement with a potential host before haustoriogen formation is initiated *or* (b) that the rootlets were not exuding the necessary chemical stimulant in sufficient quantities for initiation (Grieve, 1975) *or* (c) that the parent root was parasitized before the rootlets had emerged. Closer examination showed that the first two hypotheses deserve further study, as rootlets arising beneath the collar were not distorted or retarded in any way, but merely displaced laterally.